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Endangering factors and their effect on adult Great Bustards *(Otis tarda)*—conservation efforts in the Austrian LIFE and LIFE+ projects

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ABSTRACT—Great Bustards face many threats, both natural (such as predation and harsh weather conditions) and anthropogenic (collisions with overhead power lines, intensive agriculture, disturbance, habitat fragmentation and -deterioration). Depending on how these issues are addressed in the countries involved, Great Bustard populations may suffer or prosper in the future. Within the Austrian LIFE and LIFE+ projects a number of conservation measures were introduced to reduce especially anthropogenic threats to Great Bustards. As a result, the Great Bustard populations in Austria and the West Pannonion region have been increasing in recent years.

Keywords: *Otis tarda*, threats, conservation, population, LIFE projects, Austria.

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Introduction

The Great Bustard *(Otis tarda)* is categorized as "vulnerable" according to the latest IUCN criteria *(Collar et al., 1994; BirdLife International, 2012)*. Apart from natural threats, like predation and harsh weather conditions, there are several anthropogenic threats to Great Bustards and their habitat. The animals avoid vertical structures such as hedges and trees and are even more alert to man-made structures because of the disturbance that accompanies them and lead therefore to habitat fragmentation and deterioration. These structures include, but are not limited to, power lines, wind farms, roads and other infrastructure. These structures pose an additional threat by increasing mortality through collisions (for wind turbines cf. *Osborn et al., 1998*; *PNAWPPM-III, 2000*; for power lines cf. *Bevanger, 1995*; *Bevanger & Brøseth, 2004*; *Drewitt & Langston, 2008*; *Jenkins et al., 2010; Rollan et al., 2010)*. Migrating birds and those birds flying to—and between—resting and feeding areas face an especially high risk *(Hanowski & Hawrot, 2000)*.

Great Bustards are especially affected because of their site fidelity, their flight characteristics and their general shyness. This was made evident in the population decline in the 1900s, which coincided with agricultural intensification, hunting and massive infrastructural reinforcement *(del Hoyo et al., 1996)*. Due to careful management, the Austrian population recovered from an all-time minimum of 60 individuals in the 1990s *(Kollar, 2001)* and reached approximately 240 individuals by 2012 (*Raab et al.*, unpublished data).

Natural threats

Predation

Predation is a threat primarily applying to eggs, juveniles and immature Great Bustards. Predation of eggs and hatchlings has been reported to be a serious threat to Great Bustards throughout their range *(Eschholz, 1996; Alonso et al., 1998; Faragó, 2005; Langgemach, 2005; Yaremchenko & Bakhtiyarov, 2006; Martín et al., 2007; Burnside et al., 2012; Rocha et al., 2012)*. Thereby nocturnal mammalian predators such as racoon-dogs *(Nyctereutes procyonoides)*, badgers *(Meles meles)* and foxes *(Vulpes vulpes)* are suspected to be the major reason for losses of clutches and chicks along with some corvid species preying upon the eggs during daytime *(Bankovics, 2005; Burnside et al., 2013; Langgemach, 2005; Rocha et al., 2013)*. Under normal circumstances predation is a natural process being beneficial for both the predator and the prey population *(Langgemach, 2005)*. However in the case of Red Foxes humans interfered in this predator-prey relationship by eliminating one of the main population limiting factors of foxes by field immunization against rabies. Combined with bustard-friendly, extensive management measures a significant increase of fox populations and an enhanced predation pressure was the consequence *(Faragó, 2005; Langgemach, 2005)*.

Within the LIFE-Nature project (LIFE05 NAT/A/000077) addressing bustard conservation of the West-Pannonian population an intensive control of predator mammals was carried out in the three main Great Bustard areas Western Weinviertel, Marchfeld and Parndorfer Platte–Heideboden. Due to arrangements with local hunters a control of fox populations was possible in order to effectively protect especially clutches and chicks of Great Bustards. To reduce predation pressure large-scale hunting took place in winter time. During the rest of the year foxes were hunted as intensively as possible within the legal framework.

Harsh weather conditions

During the breeding season heavy rain can have negative impacts on the reproductive success of Great Bustards in several ways. Heavy rain in combination with disturbances, such as grazing domestic animals or predators, making the hen leave the nest and can lead to a complete abandonment of the wet nests with the uncovered, cooled eggs *(Bankovics, 2005)*. Even without previous disturbance long-lasting periods of rain can cause a flooding of the whole clutch *(Bankovics, 2005)*. Furthermore, heavy rain and downpours during the hatching period can increase mortality among the small, downy chicks due to their lowered thermoregulation capacity *(Morales et al., 2002; Bankovics, 2005)*.

Harsh winters may represent a critical period for Great Bustards *(Bankovics, 2005; Faragó, 2005)*. Food shortage due to a deep, persistent snow cover can cause losses because of starvation *(Eschholz, 1996)*. Furthermore it can force Great Bustards to leave their wintering areas *(Bankovics, 2005; Faragó, 2005; Streich et al., 2006)*. These facultative migration movements can also result in heavy losses because of moving through unfamiliar sites *(Eschholz, 1996; Faragó, 2005)*. In winter females and their offspring join flocks with other families and non-breeding females *(Alonso et al., 1998; Morales et al., 2002)*. In these winter flocks juveniles still depend on their mother and mother-offspring feedings are reported *(Alonso et al., 1998; Morales et al., 2002)*. Such long-lasting maternal effort in combination with the harsh environmental conditions makes the winter months a critical period especially for the females. Therefore, an improvement of the females' condition over the winter through sufficient food supply will result in an enhanced productivity in the following breeding season *(Morales et al., 2002)*.

While it is very little that can be done to reduce the negative consequences of unfavourable weather conditions during the breeding season, effects of harsh winters can be mitigated by ensuring access to some food throughout the winter *(Raab et al., 2014)*. Hence the risk of starvation as well as the likelihood of escape flights during winter months can be reduced.

Habitat requirements and related threats

Agricultural intensification

As an inhabitant of an open landscape largely free of trees and shelter belts *(del Hoyo et al., 1996)*, the Great Bustard is usually confronted with habitats dominated by agricultural land use systems. Therefore agricultural intensification, accompanied by agricultural specialisation and price policy *(Nagy, 2009)*, have negative impacts on Great Bustard populations due to the loss of suitable habitat *(Osborne et al., 2001; Suárez-Seoane et al., 2002; Moreira et al., 2004; Alonso et al., 2005; Pinto et al., 2005)*.

In Great Bustards the selection of foraging habitat underlies seasonal changes in response to food availability and specific habitat requirements *(Moreira et al., 2004; Palacín et al., 2012)*. During the breeding season males choose fallows over other habitat types whereas female Great Bustards primarily use cereal fields or fallows as nesting sites *(Morgado & Moreira, 2000; Moreira et al., 2004; Magaña et al., 2010; Rocha et al., 2013)*. During the winter months herbaceous plants such as cultivated lucerne *(Medicago sativa)* and oilseed rape *(Brassica napus)* become also important *(Faragó, 1996; Kurpé, 1996; Lane et al., 1999; Kalmár & Faragó, 2008; Raab et al., 2014)*.

Thus maintaining a mosaic of different habitat types seems to be essential for providing a suitable environment to Great Bustards *(Moreira et al., 2004)*. Agricultural intensification, however, leads to a simplification of the landscape and loss of necessary habitats *(Moreira et al., 2004)*. Therefore the implementation of a rotational crop system can promote a bustard-friendly habitat mosaic *(Moreiera et al., 2004; Martín et al., 2012)*. Since crop systems of such type offer little profit, financial subsidies should be provided to involved farmers *(Moreiera et al., 2004)*.

Within the LIFE-nature project LIFE05 NAT/A/000077 around 5,500 ha of arable land were cultivated in a bustard-friendly manner by means of the Austrian Rural Development Programme. This involved for example the cultivation of special Great Bustard fallows, on which the use of fertilizer or any plant protection agent were prohibited and which is subject to special mowing restrictions. Furthermore, cultivation of winter wheat was also supported. Being a preferred breeding habitat, the access was prohibited to these Great Bustard winter wheat fields between April 20th and harvest time similarly to the irrigation of these fields to avoid disturbance. In addition, suitable winter grazing areas for Great Bustards were supported by means of the Austrian Rural Development Programme.

Human disturbance

Different recreational activities, traffic (including also agricultural and air traffic) or domestic animals represent common sources of human disturbances for Great Bustards *(Bankovics, 2005; Sastre et al., 2009; Torres et al., 2011)*.

Beside the source of disturbance also the main characteristics of disturbances such as frequency of occurence, disturbances per unit time and type of response shown by Great Bustards may be useful for conservation management to identify the most harmful sources of disturbances for Great Bustards *(Sastre et al., 2009)*.

According to the response human disturbance cause in Great Bustards two categories can be distinguished. “Low-risk threatening factors”, such as tractors or sheep herds, cause variable reactions in Great Bustards, but running is a typical response shown in these cases *(Sastre et al., 2009)*. “High-risk threatening factors” (cars, pedestrians, helicopters, etc.) usually cause a flight response in Great Bustards *(Sastre et al., 2009)*. Such escape flights are classified as “highly risky” as they can have severe impacts on the energy budget of Great Bustards *(Sastre et al., 2009)*. Moreover, the risk of collisions with power lines is increased by such escape flights *(Sastre et al., 2009)*.

In the main distribution areas of the West-Pannonian Great Bustard population human disturbances causing a flight response in bustards are associated with agricultural activities, traffic or recreational activities. Monitoring also has a certain effect.

In four of the five main distribution areas, traffic (including agricultural traffic, like harvesters or tractors and air traffic, such as helicopters) is the main disturbance source leading bustards to take-off. In “Marchfeld” agricultural activity—i.e. farmers working on the fields—is the main source of disturbance.

Also in other studies traffic has been reported to be a main cause of disturbance for Great Bustards *(Bankovics, 2005; Sastre et al., 2009)*, what is also reflected by the birds’ avoidance of human infrastructures such as roads or tracks in habitat selection *(Lane et al., 2001; Osborne et al., 2001; Alonso et al., 2012; Palacín et al., 2012; Burnside et al., 2013)*. Therefore restricted access should be established at least at the main Great Bustard areas to keep the disturbance level low *(Sastre et al., 2009)*. Great Bustards may benefit from this lowered disturbance level especially during the most sensitive periods of the year. During the breeding season disturbances can interrupt mating activities *(Nagy, 2009)* or can even cause nest abandonment *(Gewalt, 1959; Ludwig, 1996)*, leading to a reduction in the reproductive success of a population. In winter an increase of vigilance behaviour due to higher disturbance levels can lead to a decrease of feeding behaviour and—combined with escape flights in response to disturbances—it would be hard to maintain a positive energy budget during short winter days *(Riddington et al., 1996)*.

Lack of public information and a limited appreciation of Great Bustards and their habitats can lead to unnecessary disturbance. Bustards, particularly in the breeding season, can be disturbed through leisure time activities such as horse riding, cycling, photography, nature observation, private aircraft or Nordic walking. Disturbance can also seriously affect reproductive success. If the females are forced to abandon the eggs or juvenile bustards due to anthropogenic disturbance for any time they are exposed to a higher risk of predation.

In the main distribution areas of the West-Pannonian Great Bustard population large parts of the road network are banned from driving, as a measure against traffic being a major source of disturbance. Although traffic still represents the major source of human disturbances, this type of threat in general cause a flight response in bustards less often than non-human sources of disturbances.

Non-human sources of disturbances mainly derive from birds of prey, especially from Imperial Eagle *(Aquila heliaca)* and White-Tailed Eagle *(Haliaeetus albicilla)*. Also other species such as Marsh Harrier *(Circus aeruginosus)* and even Saker Falcon *(Falco cherrug)* were recorded to cause a flight response in Great Bustards of the West-Pannonian population. Beside birds of prey European Roe Deer *(Capreolus capreolus)* and other Great Bustards are also among the sources of non-human disturbances.

Human-associated habitat loss

By 1,000 BC extensive deforestation took place in the course of human civilization to expand cropland and grazing land areas *(Kaplan et al., 2009)*, creating habitats potentially suitable for Great Bustards. In Iberia and Central Europe for example the key areas of Great Bustard distribution are currently situated in a landscape where they could not have been present a few thousand years ago *(del Hoyo et al., 1996)*.

However, over the years satisfying human needs while maintaining intact ecosystem functions at the same time became more and more difficult due to the ongoing expansion of human civilization and development *(DeFries et al., 2004)*. The maximisation of food production for example led to modern agro-ecosystems, characterised by the use of fertilizers and a depleted biodiversity and habitat heterogeneity due to monocultural farming *(Kareiva et al., 2007)*. This maximisation of production also created surplus, being the basis for global trading and huge areas of land were covered by roads to facilitate the increasing trade activity *(Kareiva et al., 2007)*. Over the time only a few pristine lands remained unaffected by human presence, roads or other infrastructure *(DeFries et al., 2004)*. Therefore Great Bustards and human civilisation became largely incompatible, as Great Bustards avoid human-made features such as villages, roads, tracks or power lines *(Lane et al., 2001; Osborne et al., 2001)*. Overhead power lines, wind farms and other structures potentially endanger flying bustards, fragment habitats and hamper exchange between subpopulations. Time and again infrastructure development leads to habitat fragmentation or deterioration. As a consequence the loss and fragmentation of suitable habitat due to the human civilisation represent a major threat to Great Bustards *(Alonso et al., 2001)*.

The fact that the world's average population density of 45 people/km² in 2000 will rise to 66 people/km² in 2050 *(Cohen et al. 2003)* underlines the importance of maintaining undisturbed, open, unfragmented and extensively managed agricultural land mixed with fallow land to ensure the viability of Great Bustard populations in the future.

Impact of transport infrastructure on birds

Our experience indicates that the habitat use of the West-Pannonian Great Bustard population is influenced by transport infrastructures, but the influence has not been quantified yet. Hence, results of studies on other bird species are more informative at the moment.

Roads, railroads and traffic

Most empirical data on the effects of infrastructure on wildlife refers to primary effects of a single road or railroad, which are easy to measure and affect the organisms directly at a local scale. Five major categories of primary ecological effects can be distinguished *(Seiler, 2001).* Habitat loss (fragmentation effect), disturbance and pollution (roads, railroads and traffic) are to be named first. Roads pollute the physical, chemical and biological environment and consequently alter habitat suitability for many species in a much wider area than they actually occupy. Although the impact of transport infrastructure on Great Bustard has been studied only tangentially, some publications prove the avoiding behaviour of Great Bustards of these landscape features *(Lane et al., 2001; Osborne et al., 2001)*. Sometimes bustards breed close to roads. Although no reliable study on breeding success of such clutches has been carried out as yet, but it may be lower, similar to evidence from studies on other bird species (e.g. *Reijnen, 1997*).

Traffic causes the death of many birds utilising verge habitats or trying to cross the road or railroad. Collisions between vehicles and wildlife are also an important traffic safety issue. Fortunately, Great Bustards are only very rarely involved in such accidents, due to their strict avoidance attitude (*Raab,* unpublished data).

Another issue of traffic may be their barrier effect. In contrast to some other bird species, Great Bustards are especially exposed to this type of threat due to their limited ability to fly. Field observations suggest that a busy highway with its effect-zone can be too big an obstacle, and the flying birds turn back just before crossing the highway (pers. obs.).

All of the above issues may combine to cumulative effects. Especially problematic is the fact that highways are usually built as far as possible from settlements, which means that they are often planned straight through the open landscape, sometimes in Great Bustard areas.

Other infrastructural development

In addition to power lines, wind farms and transportation, many other infrastructural developments endanger Great Bustards and their habitat. These are among others the expansion of suburbs, hypermarkets and shopping centres, industry zones, the building of airports, entertainment grounds, leisure parks, photovoltaic power stations, open surface mines, etc. The negative effect of these infrastructures is ultimately very similar to those mentioned before.

The development of airports is a problem for Great Bustard areas not only in the surrounding of big cities (e.g. Berlin, Vienna, Bratislava, Budapest), but occasionally in rural areas, too, where airports are built for low cost airlines. In the past years many industrial estates and shopping centres were built in rural areas. One can find this “new” kind of infrastructure in almost every bigger village by now. In addition, leisure parks and golf courses are also encroaching as a new threat to Great Bustard areas and will be of an even greater importance in the future. Only a few Great Bustard areas have been destroyed by gravel mines in the last century, but some Great Bustard areas are still threatened by the establishment of new ones.

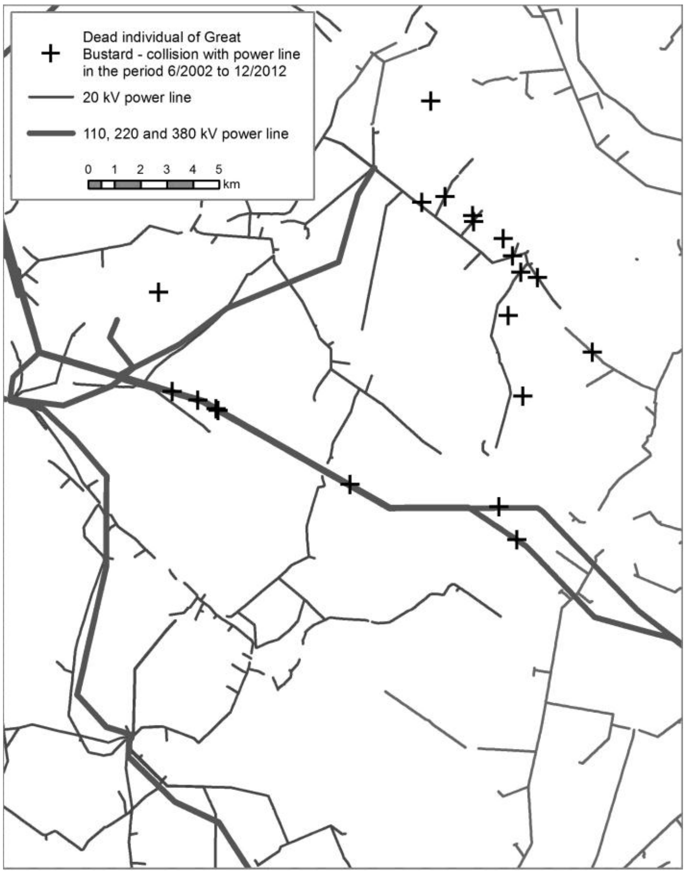

Figure 1. Example for the endangering factor ‘collision with power lines’ of the West-Pannonian population of Great Bustard in the area “Parndorfer Platte–Heideboden”. A total of 20 dead individuals of Great Bustard were found in this area in the period between June 2002 and December 2012. In all cases collision with power lines was proven as a cause of death.
1. ábra. Példa az elektromos légvezetékekkel történő ütközés okozta veszélyre a Parndorfer Platte–Heideboden környéki nyugat-pannóniai túzokpopuláció esetében. 2002. június és 2012. december között 20 elpusztult túzok került elő; valamennyi esetben légvezetékkel való ütközés volt a halálok. A kereszt jelzi az elpusztult példányok helyét, a 20 kilovoltos vezetékeket vékony, a 110, 220 és 380 kilovoltos vezetékeket vastag vonal jelzi.

Afforestation, shelter belts, orchards, vineyards

Evidence for an effect of afforestation, shelter belts, orchards, vineyards on Great Bustard is anecdotal; it is generally assumed that the presence of woody areas affects the distribution negatively. In scientific studies (e.g. *Lane et al., 2001; Faragó & Kalmár, 2006; 2007; Kalmár & Faragó, 2008)* these habitats are usually listed among minor or ’other’ crops. On the other hand, in Spain droppings were often packed with olive stones *(Lane et al., 2001)* which prove the presence of Great Bustards in olive plantations. Additionally, during heat waves or during chilly wind the animals sometimes crouch in the shadow of tree lines and shelterbelts (pers. obs.), but these observations are exceptions to the rule.

The habitat loss caused by afforestation and fragmentation by shelter belt plantations was surely catastrophic for example to the population in Hanság, Hungary, whereby the habitat was totally destroyed *(Faragó, 1979)*, and this changes in habitat can be a recent problem at many sites all over Europe.

Bustards in flight—why vertical structures are a problem

The male Great Bustard is the heaviest flying bird in the World (together with the male Kori Bustard—*Ardeotis kori, Alonso et al., 2009).* While they are tireless fliers and can cover distances of more than 300 km per day *(Watzke, 2007)*, their manoeuvrability is limited by their heavy weight and large wingspan. They regularly fly either locally or over larger distances because of disturbance, seasonal change of habitat preferences, occasional visits to previously inhabited sites, flights between different subpopulations, dispersion and facultative migration on harsh winters.

The vulnerability of Great Bustards to power lines and other vertical structures arises from the characteristics of the species. Great Bustard movements during night have been recorded by some observers *(Gewalt, 1959)*, but basically this happens only when birds are disturbed, as Great Bustards do not migrate at night. As Great Bustards have small and broad wings combined with high wing loads they are classified as "poor flyers" according to Rayner's categorisation *(Rayner, 1988)*, making rapid reactions to unexpected obstacles difficult *(Bevanger, 1998)*. Visual field topographies may also represent a key aspect in explaining the high collision risk of Otididae with power lines and other vertical structures *(Martin & Shaw, 2010)*.

Collisions with power lines and similar obstructions

Wire fences, electric fences, overhead cables of electrified railways, telephone cables impose a similar risk to power lines; clearly, electric power lines are the most widespread of all. There are ca. 58 000 km medium voltage aerial power lines in the 93 000 km² area of Hungary e.g. *(Horváth et al., 2008)*. However, other aerial cables (for example overhead contact lines) can pose a greater threat to Great Bustards in some areas according to the *MoU Hungarian National Report (2008)*. Collisions with power lines occur where there is an array of overhead power lines inside bustard ranges, in surrounding areas, or across flyways between different ranges. Collision with power lines is actually the main mortality factor for fully grown (i.e. immature and adult) Great Bustards in many areas (e.g. *Martín et al., 2004; Palacín et al., 2004)*. Power lines have frequently been reported to be lethal obstacles for Great Bustards *(Janss & Ferrer, 1998; Janss, 2000; Reiter, 2000a; Alonso et al., 2005; Martín et al., 2007; Raab et al., 2011; 2012)*. Typical injuries from collision with power lines are broken wings, cuts on the neck and the breast.

Additionally, the risk of collision increased if such man-made structures were placed on or near areas regularly used by larger numbers of feeding, breeding or roosting birds or on local flight paths, for example between foraging and nesting or roosting areas *(Everaert & Stienen, 2007)*.

Artificial structures can also lead to habitat fragmentation as they influence the spatial movements of Great Bustards *(Raab et al., 2011)*. Although the adaptation of flight routes after take-off in order to avoid the crossing of nearby power lines may reduce the risk of collision, at the same time it may have severe impacts on the spatial movements of Great Bustards within their distribution area *(Raab et al., 2011)*.

One way to mitigate the risk of power line collisions is a contrast enhancement of wires against the background by using power line markers such as coloured PVC spirals or avian flight diverters at already existing power lines *(Alonso et al., 1994; De La Zerda & Rosselli, 2003; Frost, 2008; Yee, 2008; Raab et al., 2011)*. For the complete elimination of any negative effect of power lines on birds, their retrofitting into the ground would be recommended over their visibility marking *(Raab et al., 2012)*.

As an example from the Austrian LIFE-projects: between 1 June 2002 and 31 May 2011 a total of 78 dead individuals were reported, of which 41% (32 birds) referred to Great Bustards having collided with power lines. The mean annual mortality rate of bustards was 3.5±1.6% between 2002 and 2010, while their mean annual collision rate was 1.6±1.3% *(Raab et al., 2012).* Power lines crossing typical Bustard habitats are especially dangerous. That was the reason why many special measures were undertaken within the Austrian LIFE-Projects to prevent future collision to power lines where a lot of dead Great Bustards had been found (cf. *Figure 1*).

Measures of the Austrian LIFE-Project: A total of 42 km of 20 kV power lines that run through important bustard areas were retrofitted, ca. 125 km of 110 kV, 220 kV & 380 kV power lines were fitted with visibility markings, and the efficiency of the marking was monitored.

The mortality rate of Great Bustards in our study area (covering 686.5 km^2, *Raab et al., 2012)* decreased significantly between 2002 and 2011, predominantly caused by reduced mortality due to power line collisions. Univariate tests indicate that underground cabling and power line marking significantly decreased power line collision casualties. Our results indicate that five years after underground cabling and marking of power lines within core areas of the West-Pannonian distribution range of the Great Bustard, the population already benefited through a significantly decreased mortality rate. Both conservation measures most likely contributed strongly to the rapid recovery of the West-Pannonian Great Bustard population observed within the last decade. Although power line marking appeared to reduce the collision risk, underground cabling explained most of the reduced mortality after implementation of these two conservation measures *(Raab et al., 2012)*.

Wind farms

Apart from direct habitat loss, which is mostly minor, there may also be an indirect loss through habitat deterioration. This might be caused by an increase in disturbance from the wind farm itself or from human activity, or by land-use changes. All may cause Great Bustards to abandon the area but quantification of the effects of wind farms can be confounded by these other changes. Disturbance can lead to displacement and exclusion from areas of suitable habitat; effectively loss of habitat to the birds. Numerous reliable studies indicate negative effects; some reviews collected the main outcomes (e.g. *Erickson et al., 2001*; *Gill et al., 1996; Horch & Keller, 2005*). The cumulative effects of large wind farms may lead to disruption of ecological links between feeding, breeding and roosting areas (*Cooper & Sheate, 2002)*. Furthermore, wind power plants always require installation of electric power lines, which introduce a serious risk itself (see above). As a consequence, cumulative impacts of various factors must be considered.

Habitat loss and fragmentation caused by wind farm development impose a higher threat to Great Bustard than direct mortality because its high fidelity to traditional leks, breeding and wintering sites. Hence, a single badly planned wind power plant can destroy very important habitats. *Wurm & Kollar (2001)* reported that a wind power plant in Parndorfer-Platte, Austria had been built occupying a large part of the Great Bustard habitats in the area. In addition, Great Bustards keep a distance of 600 meters from wind towers.

The pressure to establish wind farms in Great Bustard areas is increasing because financial conditions are highly favourable at the moment for generating wind energy and production of renewable energy is also supported. For several years, wind farm development projects have caused most of the conflicts between nature conservation and infrastructure development on both sides of the Hungarian–Austrian border of the West-Pannonian Great Bustard areas, similarly to Brandenburg, Germany according to the Hungarian, German and Austrian national reports to the MoUGB in 2008. It is likely that this pressure will affect other sites in the near future, too.

Conclusions

Adult Great Bustards face many threats, both natural (such as predation and harsh weather conditions) and anthropogenic (collisions with overhead power lines, intensive agriculture, disturbance, habitat fragmentation and deterioration). It is up to conservation efforts in the countries involved to deal with these issues and determine the severity of the impacts of these threats.

In Austria for example, only through the collaboration of farmers, hunters and local politicians with the conservation project "Great Bustard" was it possible to create suitable breeding sites and protect them against disturbance. Farmers made use of the Austrian agri-environment scheme "ÖPUL" by cultivating special bustard fields. Farmers and hunters were helping to keep disturbance in Great Bustard areas as low as possible and were also involved in the successful control of the Great Bustard conservation actions (monitoring). Additional 42 km of 20 kV power lines that run through important bustard areas were replaced by underground cables and ca. 125 km of 110 kV, 220 kV & 380 kV power lines were marked to enhance visibility to bustards within the Austrian LIFE-Project. As a result, the Great Bustard populations in the West Pannonion region have been increasing in recent years.

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KIVONAT—A túzokokat veszélyeztető tényezők közt egyaránt vannak természetesek (mint a predáció vagy a mostoha időjárás) és antropogén eredetűek (pl. elektromos légvezetékek, intenzív mezőgazdálkodás, zavarás, élőhelyük csökkenése és romlása). A túzokpopulációk pozitív vagy negatív irányú változása nagyban függ attól, hogy az érintett országok miként kezelik ezeket a tényezőket. Ausztriában számos túzokvédelmi beavatkozás történt különösen az antropogén eredetű veszélyforrások hatásainak csökkentésére a LIFE és LIFE+ projektek keretében. Ezeknek köszönhetően nemcsak az osztrák, hanem a teljes nyugat-pannon populáció is folyamatosan növekszik az elmúlt években.

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